

KNOWLEDGE MANAGEMENT AND ORGANIZATIONAL LEARNING AT NUCLEAR AND RADIATION SAFETY CENTER

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Abstract

Establishment of the knowledge management system at the Nuclear and Radiation Safety Center, which is a technical support organization of the Armenian Nuclear Regulatory Authority, is a continuous process that was initiated in parallel to the company establishment and improved based on the company needs and experience. It has a purpose to create, collect and share the knowledge with the employees who need it. The knowledge management system is integrated into the company Quality Management System. The objective of this paper is to describe the knowledge management model applied in the Nuclear and Radiation Safety Center, which covers all the aspects related to knowledge creation, obtaining, maintaining, retaining and transfer.

Keywords: knowledge management, need for knowledge, knowledge creation, knowledge share, knowledge storage, knowledge management model

1. INTRODUCTION

Knowledge is one of the most valuable assets for an organization. The effective management of knowledge is recognized as an important element for sustaining competitive advantage and improving performance.

In any organization knowledge is constantly being created and shared. Unfortunately, this relevant knowledge could be often lost as it was not properly documented in due time. The worse situation is when the employees leave the company, and all the knowledge and information they have contributed leaves with them. This is crucial for the companies and the sector in general suffering from the lack of qualified specialists.

Knowledge management is an important part of organizational learning. It is a systemic effort to decide what the organization needs to know, how to develop this knowledge and thus maintain the competitiveness in the market.

The necessity to apply the elements of knowledge management at the Nuclear and Radiation Safety Center (NRSC) has been already recognized at the stage of company establishment. After shut-down of both units of the Armenian Nuclear Power Plant (ANPP) in 1989 and collapse of the Soviet Union in 1991, the scientific institutions providing technical support to ANPP were closed down and most of specialists left Armenia in search of work, taking with them all accumulated knowledge. In 1993 the Government of the Republic of Armenia made a decision to restart ANPP. Armenian Nuclear Regulatory Authority (ANRA), which was established the same year, faced difficulties with implementing regulatory oversight during ANPP restart due to limited staff and knowledge, and lack of local technical support. Some technical assistance received from the International Atomic Energy Agency (IAEA), United States Nuclear Regulatory Commission (U.S. NRC) and European Commission (EC) was not enough to cover the gaps. The best, but risky solution to get out of this situation was to establish the local technical support organization. The

idea was supported by the Government of the Republic of Armenia and in 2001 NRSC was established.

Initially only five specialists worked for NRSC. Many specialists simply rejected invitation to join the company as nobody believed that the company will survive and effectively operate. However, NRSC not only survived but also expanded the scope of its activities, developed capabilities and nowadays this is the leading expert organization in the field of nuclear and radiation safety in the local market and the most reliable partner for international organizations.

The most important factor in this success was the approach to the knowledge management adopted by the company since its establishment. In conditions of lack of qualified specialists, the only possible solution was to attract students and new graduates, and to organize their training and learning in place, with support from international organizations, thus forming a team of professionals and developing company capabilities.

This paper describes the knowledge management model and the elements of organizational learning applied at NRSC.

2. KNOWLEDGE MANAGEMENT SYSTEM

Knowledge management (KM) is an integrated approach to identify, create, classify, store, share and apply knowledge to enhance the organizational productivity, quality, profitability and growth. KM is a process through which NRSC generates value from its intellectual and knowledge-based assets.

KM system of NRSC is focused on both individuals and teams. Increased knowledge and skills of individuals enhance the entire team's capability, which, in its turn influences organizational capabilities and brings to development of core competencies.

The most important objectives of KM process within NRSC [1, 2] are to maintain and further develop the company technical competence with regards to:

- Status of science and technology;
- Knowledge-oriented planning and implementation of projects;
- Distribution and sharing knowledge;
- Utilization of knowledge;
- Making knowledge and knowledge processes more explicit;
- Introduction of more systematic methods to the management of knowledge.

KM is an element of NRSC Quality Management System (QMS) and is included in the system as a supporting process. Description of KM related processes is provided in the QMS handbooks.

3. KNOWLEDGE MANAGEMENT MODEL

KM model used at NRSC covers the following main processes (see Figure 3.1):

- Identification of need for knowledge;
- Knowledge creation;
- Knowledge share;
- Knowledge storage.



Figure 3.1. NRSC KM process model

Detailed description of each of the processes is presented in the sections below.

3.1 Identification of need for knowledge

Before knowledge can be shared or created, the need for knowledge has to be identified. Further requirements to it have to be determined to allow finding the right knowledge in case of sharing and to enable creation of right knowledge in case of creation [2].

The need for knowledge is identified through:

- Analysis of working processes to identify shortcomings that lead to need for additional knowledge;
- Starting activities in new areas;
- Investigation of development trends and changes in scientific environment (new methods, tools, approaches, etc.);
- Analysis of completed projects (i.e. lessons learned);
- Annual performance evaluation of company staff.

The need for knowledge is identified at:

- Individual level;
- Team level;
- Organizational level.

Knowledge needs identified at individual level are reflected in Personal development plans, prepared for each NRSC employee based on the results of annual performance evaluation [3] and/or are included as topics in the Individual training programs (see Section 3.2).

Knowledge needs identified at a team level are included in the Group passports [4-8]. These are the documents developed for all technical directions (groups) of NRSC activities which describe in details:

- Group purpose;

- Scope of group activities;
- Group structure and distribution of responsibilities among group members;
- Software tools used by the group;
- Special equipment used by the group;
- Group capabilities;
- Group development program (identification of needs for knowledge) with defined priorities;
- Regulations, literature, training materials, manuals, any other documents defined by the group, which are used in daily work.

Group passports are living documents which are periodically updated. The needs for knowledge identified in the group development programs are becoming a part of NRSC development program and transferred into knowledge through knowledge creating possibilities identified in Section 3.2.

Knowledge needs at the company level are general strategic goals described in NRSC Business plan, which is prepared annually.

A good example of a timely identified need for knowledge is starting application of Computational Fluid Dynamics (CFD) codes and establishment of Multiphysics Simulation Group within NRSC organizational chart. CFD applications are currently widely used for safety justification of NPP specific safety issues and are the most up-to-date methods. These issues are often related to situations where the 3D aspects of flow and geometrical effects have a significant influence on the safety criteria. Turbulent mixing is a common feature of these flows and the degree of mixing controls the result which directly affects safety. CFD tools are able to model small scale mixing phenomena with a fine space resolution and could be a very powerful tool for better understanding of physical behavior.

The CFD repertoire of NRSC currently consists of ANSYS software package which was provided to NRSC under the United States Agency for International Development (USAID) assistance program, including corresponding training. Currently ANSYS-CFX is in wide use by NRSC in its technical support activities to ANRA with regard to safety assessment of ANPP.

NRSC experience, passed trainings and accumulated knowledge in application of CFD codes are described in details in “ANSYS Application Methodology” handbook [14], which is an element of knowledge sharing (see Section 3.3) and a training material for newcomers (see Section 3.2).

Another good example for evaluating NRSC knowledge status and identifying needs for knowledge is regular participation in the recognized international topical meetings, like CAMP (U.S. NRC Code Applications and Maintenance Program), PSAM (Probabilistic Safety Assessment and Management Conference), PHYSOR (The Physics of Reactors Conference), NURETH (International Topical Meeting on Nuclear Reactor Thermal Hydraulics), and others. Participation in these meetings contributes not only to the process of identifying NRSC needs for knowledge, but also to the other elements of KM process, such are knowledge creation (see Section 3.2) and knowledge sharing (see Section 3.3). Familiarization with the experience of other countries/companies is on one hand a good learning possibility, and on another hand right place to determine NRSC knowledge status, evaluate applicability of the other countries’ experience to NRSC and generate ideas for further development. NRSC knowledge/experience is in its turn shared with other participants.

3.2 Knowledge creation

New knowledge is created in cases when no existing knowledge matches the requirements of identified need for knowledge. This process could be combined with the elements of so called “Knowledge pull” [2], which covers searching for existing knowledge with the purpose to re-use it.

An examples of “Knowledge pull” are:

- Feeding knowledge to NRSC experts (through participation in trainings, workshops);
- Involvement of specialists possessing required knowledge (practiced in cases when the knowledge is required for single or short-term use);
- Buying knowledge itself (software, method, etc.).

New knowledge is created through:

- Research and development projects;
- Internal projects;
- Participation in international benchmarks;
- Expert support;
- Individual training programs;
- Participation in trainings, workshops, recognized topical meetings, etc.

The distinctive feature of knowledge creation is that in most cases this does not immediately brings a value and is even costly, however this is a good investment for further benefits if the need for knowledge was identified in time and the requirements were set correctly.

As the main company value is its staff, and actually this is the staff who contributes to the development of team’s and company’s capabilities, at NRSC the main emphasis is done on knowledge creation at individual level (training of staff), moreover that the main problem existing in the field is a lack of qualified specialists.

Training of NRSC newcomers is conducted according to the training programs developed for all main categories of NRSC technical staff. These are typical templates, which are adjusted in each particular case to the needs of trainees depending on their experience and the level of basic knowledge (educational knowledge). Training programs cover both theoretical and practical parts, and include:

- Introductory course;
- Specialized course.

Training courses are formulated as internal projects. Training is conducted by a team of NRSC experts. If necessary, external experts could be involved. Each trainee has an immediate supervisor, who is taking responsibility for preparation, processing and review of training program, and organizing all the aspects related to organization of effective training for trainee.

The main advantage of NRSC approach to training is that from the moment of joining the company trainees become equal right NRSC staff members and have the opportunity to participate in projects, workshops, training courses and other educational activities, like other staff has. In training activities the main emphasis is done on on-the-job type of training.

An average duration of training course is three years. It is assumed that after completing the full course trainees should be able to independently carry out their duties.

Training program is a living document and could be revised at any time depending on the company and individual needs. Training performance and progress is continuously monitored through presentations during NRSC weekly seminars and during annual performance evaluation.

NRSC is preparing new specialists not only for its needs but also for ANRA. This activity is a task within annual contract with the Regulatory body. Besides it, NRSC experts are actively involved in preparation of specialists with specialization in the field of nuclear and radiation safety in the Republic of Armenia as a whole, through teaching the courses in reactor physics at the Yerevan State University and State Engineering University, as well as providing trainings in the field of nuclear and radiation safety to other organizations on a contract basis.

Training of staff is a continuous process and includes not only training of newcomers but also re-training (advanced training) of existing staff. This activity is organized through:

- Initiation of research and development activities;
- Conducting internal projects;
- Participation in international benchmarks;
- Expert support;
- Participation in trainings, workshops, recognized topical meetings, etc.

3.3 Knowledge sharing

The general purpose of KM is to make knowledge usable for more than one individual, e.g. for an organization as a whole; that is, to share it.

This process could be combined with the elements of so called “Knowledge push” [2], which covers “feeding” knowledge to the recipients who are known to be in need of it. This is important because people will not search for specific topics concerning their everyday work over and over again.

Knowledge sharing is done by regular or event triggered knowledge sharing occasions.

Good example of regularly organized knowledge sharing event is NRSC weekly meetings (seminars). These are organized twice per week with the main purpose to inform the staff on the progress in NRSC activities, new endeavors, to discuss the project related topics and lessons learned, as well as to share with the rest staff new knowledge/ideas received through participation in different knowledge creating events, such are trainings, workshops, topical meetings.

3.4 Knowledge storage

Currently, information and knowledge are stored at NRSC in the following formats:

- Electronic documentation;
- Paper documentation;
- Electronic knowledge (implicit and explicit knowledge);
- Employee’s brains (tacit knowledge).

The main purpose is to increase the share of electronic documentation (to make transition from paper to electronic office) and to transfer tacit knowledge to explicit knowledge thus preserving the knowledge from lost.

The main repositories for knowledge storage at NRSC, which are accessible for whole NRSC staff, are:

- Library;
- TECHLAB (electronic library);
- Intranet;
- QMS documents (handbooks).

3.4.1 TECHLAB

TECHLAB is a database of regulatory documents, technical reports, publications, training materials, etc. The materials can be registered as:

- Hard copy;
- Electronic copy;
- Any kind of information carrier (CD, USB flash drive, etc.).

For each document registered at TECHLAB the following main characteristics are defined:

- Document ID;
- Category;
- Title;
- Description;
- Issued Country;
- Author;
- Place of storage;
- Keywords.

TECHLAB gives search possibility by the same characteristics (see Figure 3.4.1.1).

REGULATORY INFORMATION SYSTEM

TECHLAB : Database of regulatory documents, technical reports, publications and other documents

You are here ►► ARIS: TECHLAB: LIST OF ALL DOCUMENTS

Login

Search

Author

Go | Show All

| Advanced

Author

Book ID

Category

Description

Keywords

Items count

Category

Keywords

Category	ID	Title	Country	Keywords	File
CD		International Conf. on Topical Issues in Nuclear Installation Safety	Austria	Nuclear Safety, PSA, The Vienna Declaration, SAM, Method Harmonization	
Training Course	2499	Basic nuclear safety concepts, regulatory function, licensing management and decision making	Armenia	Nuclear safety, nuclear regulatory authority, NPP safety functions, Depth concept, regulatory inspection, regulatory transparency	
Safety Fundaments	2498	Годовой отчет по оценке состояния безопасности при эксплуатации энергоблока N2 ААЭС за 2016 год	Armenia	состояния безопасности	
Safety Fundaments	2497	«Отчет о расследовании нарушения в работе АС (2АРМ-06-03-01-17 от 05.02.2017г. - Отключения ТГ-3 действием дифференциальной защиты трансформатора Т-3» (հավանքահ ռիսկիմիջոցառումները)	Armenia	расследование нарушений	
Technical Report	2496	«ՕՏՇԵՏ ԲՆԱԼԻԶՅՈՒ ՏԵՆԴԵՆԿԻՅ ԴՈՒՅՄԱՆԻՅ» ՄՍ.ԱԴԸ 45_ՕՕ3-003 ռիսկիմիջոցառումները	Armenia	тенденции, события	
Safety Requirements	2495	TRAINING AND KNOWLEDGE DEVELOPMENT FOR USE OF SOFTWARE FOR SAFETY ANALYSIS INCLUDING ANSYS Subtask 2.1.5 Simulation of NPP Problems for Training Purposes – Spray Nozzle Modeling and Simulation NRSC-RT-USAID-001/13-T2.1.5-001	Armenia	ANSYS: spray nozzle; modeling; simulation	
Safety Requirements	2494	TASK 2.2 ORGANIZATIONAL OPTIMIZATION AND ACTIVE USE OF THE SOFTWARE FOR SAFETY ANALYSIS, INCLUDING ANSYS Subtask 2.2.2 ANSYS Application Methodology	Armenia	ANSYS; methodology	
Safety Requirements	2493	TASK 1.1 Subtask 1.1.6 Detailed study of analyses of hydrogen combustion in	Armenia	hydrogen; combustion; CFX	

Figure 3.4.1.1. TECHLAB

The categories of documents registered at TECHLAB are:

- Literature;
- Regulatory documents;

- QMS documents;
- Project files;
- Software tools;
- Workshop proceedings;
- Other materials.

TECHLAB is accessible to all NRSC staff and any type of required information/knowledge could be easily retrieved from this database.

3.4.2 Intranet

Information which has to be accessible to whole NRSC staff or a part of it is shared via Intranet (local network) (see Figure 3.4.2.1). This is the main storage repository for project related documentation and QMS documents. Access to information is defined by the granted access permissions.

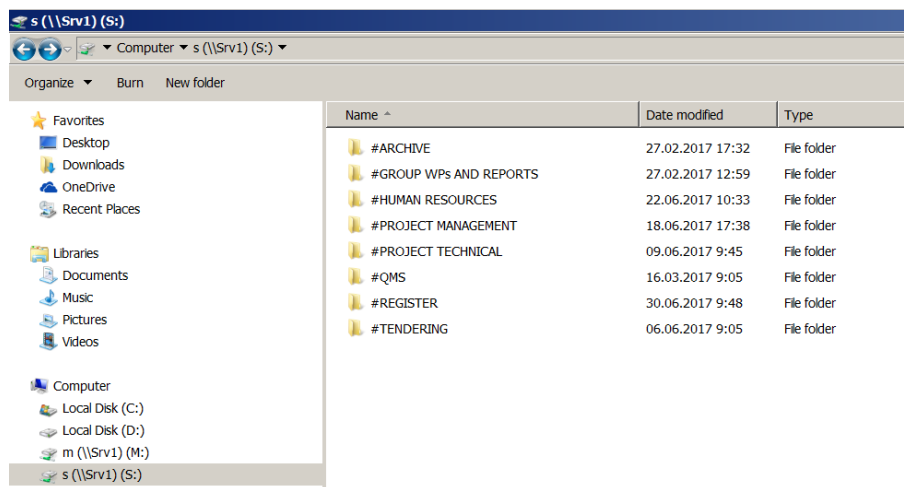


Figure 3.4.2.1. NRSC local network

3.4.3 QMS documents

Created knowledge is described in NRSC internal documents, called “Expertise Handbooks”, which are constituent part of NRSC QMS [9-13]. Separate documents are developed for nuclear and radiation safety areas of NRSC activities, including:

- Expertise handbook for nuclear safety:
 - Part 1: Core and nuclear fuel;
 - Part 2: ANPP technological system;
 - Part 3: Probabilistic assessment of risk;
 - Part 4: Thermal hydraulic analyses.
- Expertise handbook for radiation safety.

Expertise handbooks are explanatory documents (manuals) describing in details how expertise/review activities are implemented by NRSC in different areas of nuclear and radiation safety. The explanations are supported by examples. The documents cover regulatory requirements as well but the main emphasis is done on description of activities coming from NRSC experience.

Expertise handbooks are living documents and are periodically updated with gained experience.

The purpose to establish such documents is to transfer tacit knowledge into explicit knowledge, and to prepare training materials for newcomers.

Another example of knowledge sharing documents developed by NRSC is an “ANSYS Application Methodology” handbook described in Section 3.1 [14].

4. CONCLUSIONS

KM system has to be working for the company to benefit from it. Working KM system enhances individual, team and organizational capability thus increasing overall productivity and quality of company activities and is becoming an important element for sustaining company competitive advantage.

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